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Noise Study for Boulder Band Shell Site

DLAA #9908

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Executive Summary

D.L. Adams Associates measured noise levels at four individual locations in Boulder Central Park. Measurements were taken at three locations during the weekend of October 10th -12th, and fourth location was monitored over the weekend of October 17th -19th. This study analyzes sound levels at the current band shell location as well as three proposed relocation sites. Results from these measurements are also compared to a similar acoustical study performed by Peak Engineering in 1995.

Sound levels at all three alternative Band Shell locations were found to be lower than sound levels at the current Band Shell location. In particular, the results from the relocation sites were significantly lower than at the current Band Shell location during the evening rush hour on Friday. Location C, on the West side of Broadway Street near the shuffleboard courts showed the lowest average sound levels. Average sound levels at the current Band Shell location were found to lower when compared with the study in 1995.

A barrier analysis of traffic noise levels on the existing Band Shell location reveals that it is unlikely noise levels can be reduced below 55 dBA. The three alternate measurement locations show more potential to meet quieter noise levels.

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1 INTRODUCTION

D. L. Adams Associates has completed the acoustical study at Boulder Central Park. This is part of an effort to assess the noise levels at the current Boulder Band Shell location, and compare the acoustical conditions to three other proposed Band Shell relocation sites. Between Friday October 10th and Sunday October 12th, we measured sound levels at the rear of the current Band Shell seating area, at a location in the park near the Boulder Contemporary Museum of Art on 13th Street, and at a location near the Boulder Public Library addition near Canyon Drive. Additional measurements were taken between Friday October 17th and Sunday October 19th at a location at the shuffleboard courts near 11th Street.

There were several overlapping events in Central Park that affected the measurements on Saturday October 11th. The farmer's market was held on 13th Street between Arapahoe and Canyon during the hours of 8:00am to 2:00 pm. In addition, there was a concert held at the Band Shell from approximately 11:00am – 2:00pm

Please refer to Appendix A for definitions of acoustical terminology such as octave band, one-third octave band, and A-weighted sound level. A chart of typical noise levels is also provided.

2 SOUND LEVEL CRITERIA

There is very little industry established criteria for ambient noise levels as they relate to an outdoor amphitheater location. Typically, the greater concern is the effect of the noise emitting from the amphitheater to the surrounding community. However, for the purposes of this study, which is more concerned with the community noise levels effect on the performance area, we present the following background noise criteria typical for indoor spaces:

Type of Space or Activity	Maximum Recommended Background Sound Level, dBA
Drama Theaters, Concert Halls	25 dBA
Large Lecture Rooms with Speech Amplification	35 dBA
General Purpose Auditoriums	45 dBA
Large Seating Capacity Spaces (Gymnasia) with Speech Amplification	55 dBA

We understand that the Band Shell is currently used for a wide variety of events, from unamplified symphonic music to amplified pop and rock concerts. It is unrealistic to expect that ambient noise levels in the middle of an active city the size of Boulder will be less than 45 dBA, much less at 35 dBA or 25 dBA desired for unamplified symphonic or speech events.

A realistic goal for the site would be to meet average levels less than 55 dBA, which would allow for amplified events.

We believe that with attention to site selection based on this measurement study and strategic and appropriate use of sound barriers in the planning and design of changes to the Band Shell, meeting an average ambient noise level of 50 dBA is possible in the Boulder Central Park area.

For most events and patrons, there is the expectation and understanding that when you attend an event at an outdoor location in the middle of the city you are exposed to more noise. In our experience, the tradeoff to a scenic outdoor setting with moderately higher background noise than one would have at an indoor venue can still lead to a positive patron experience, as long as the program sound level is high enough to overcome the majority of the background noise.

3 MEASUREMENT LOCATIONS

We measured *long-term* sound pressure levels with unattended sound level meters at four locations, designated Locations A, B, C, and D. Please refer to Figure 1 for an aerial photo of Locations A, B, C, and D. We also monitored s*hort-term* sound pressure levels at all locations to identify specific traffic or noise events and associated noise levels. Locations A, B, C, and D are further described and shown by photographs below.

3.1 LOCATION A

Center of the back row of the existing pew seating at the Boulder Band Shell.

This location was selected because it represents the current conditions at a typical listener's seat. Measurements taken by Peak Engineering in 1995 were also conducted from this location in the seating area. The dominant noise sources at this location are from traffic on Canyon Boulevard as well as from traffic on Broadway Street. Other than the Band Shell itself, there are no physical barriers that mitigate noise from any of the nearby thoroughfares.

The photo below shows Location A.

Photo 1 - Location A, looking north towards the Band Shell

3.2 LOCATION B

Central Park near the Boulder Contemporary Museum of Art, 236’ feet from Arapahoe Ave, 31’ from 13th St.

This location was selected because it represents sound levels in the southeast quadrant of Central Park. This location is closer to 13th Street than the busier Arapahoe, Canyon and Broadway streets, however traffic from these busier streets can be heard at Location B. The nearby creek can also be heard and contributes to the ambient sounds.

The photo below shows Location B.

Photo 2 - Location B, looking west towards Central Park and bridge on Broadway over Boulder Creek.

3.3 LOCATION C

At the light pole over the shuffleboard courts near 11th Street.

This location was selected because it represents sound levels in the central quadrant of the park between Broadway Street and the Boulder Public Library. Traffic noise from Broadway Street and Arapahoe Ave is audible at this location. The Boulder Creek can also be heard. There is fairly significant acoustic shielding from the nearby buildings, blocking some noise from both Broadway and Arapahoe. The addresses listed on these buildings are 1101 Arapahoe Ave and 1739 Broadway St. It should be noted that if these buildings were taken down, the noise levels from traffic on Arapahoe and Broadway would most likely increase at Location C.

Photo 3 - Location C, looking west towards Boulder Public Library parking lot.

3.4 LOCATION D

The Boulder Public Library addition off of Canyon Dr.

This location was selected because it represents sound levels in the western quadrant of the park near the Boulder Public Library. Traffic noise from Canyon Drive is audible at this location, and is the dominant noise source. The Boulder Creek can also be heard. There is also a lot of foot traffic along the Boulder Creek Path, which is within 10' of the measurement location. There is acoustic shielding from the Library to the West, blocking some noise from 9th St and Canyon Drive.

It should be noted that the equipment at Location D was tampered with during the measurement period. Bungee cords were stolen and someone attempted to open the locked case. We believe this happened early on Saturday October 11th between the hours of 12:30 – 3:00 am. We also believe that people were talking or yelling directly into the microphone around this period of time.

Photo 4 - Location D, looking east towards Boulder Creek Path and Broadway St.

4 MEASUREMENT PROCEDURES AND INSTRUMENTATION

4.1 MEASUREMENT PROCEDURES

On Friday, October 10, 2014, a sound level meter was placed at Locations A, B, and D. The three sound meters measured sound levels continuously from the morning of October 10, 2014, until the evening of October 12, 2014. The measurements at Location A consisted of a continuous series of one-hour measurements. The measurements at Locations B and D consisted of a continuous series of fifteen minute measurements. The meter at Location C measured sound levels in fifteen minute intervals from the morning of October 17th to the evening of October 19th.

Each measurement includes overall A-weighted (dBA), octave band, one-third octave band, and statistical metric sound levels. The statistical metrics include L_1, L_{10}, L_{25}, L_{50}, L_{90}, L_{99}, L_{MIN}, and L_{MAX}. The audio signal was recorded for a 15 second period at the beginning of each measurement. These recordings can be listened to and are sometimes useful to identify sound

sources.

We measured short-term overall a-weighted sound levels using a handheld sound level meter at Locations A, B, C, and D. This was done to identify the sound level of a typical car, bus or other common sound sources at each location.

4.2 INSTRUMENTATION

All noise measurements were taken with Larson Davis 831 sound level meters as described below.

Location A: Larson Davis Model 831 (S/N 0002499) sound level meter with a PCB Model 377B20 (S/N 124491) ½" random incidence microphone.

Location B: Larson Davis Model 831 (S/N 0001435) sound level meter with a PCB Model 377B20 (S/N 105289) ½" random incidence microphone.

Location C: Larson Davis Model 831 (S/N 0002499) sound level meter with a PCB Model 377B20 (S/N 124491) ½" random incidence microphone.

Location D: Larson Davis Model 831 (S/N 0001349) sound level meter with a PCB Model 377B20 (S/N 108760) ½" random incidence microphone.

Calibration of the measurement system (sound meter, preamp, and microphone) was checked in the field before and after the measurements with a Larson-Davis CAL200 Acoustic Calibrator (S/N 5323).

All equipment meets the ANSI S1.4 Type 1 standard. Meters were set on "Slow" response. A windscreen covered each microphone. The calibration of all sound meters, microphones, and calibrators has been certified by the manufacturer's laboratories within the manufacturer's recommended time periods.

5 WEATHER

Weather and meteorological conditions can influence measurements such as this. Wind can have a significant effect on ambient noise levels due to noise from rustling leaves, grass, etc. Though water in roads can decrease traffic speeds which in turn decreases noise from engines, wet roads increase noise levels from tire contact. Generally, the tire to road contact is the dominant noise source for average to small size cars. In the case of large trucks or busses, the engine noise tends to be the dominant source.

There was no significant precipitation recorded in Boulder during the measurement periods. On the evening of Saturday October 11th, average wind speeds were recorded at 10 mph between the hours of 6:00pm and 12:00am. The wind then steadily increased to 19 mph between 12:00pm

and 6:00pm on Sunday October 12th.

6 SOUND LEVEL RESULTS

6.1 LONG TERM SOUND LEVELS

Hourly or 15 minute average A-weighted L_{EQ}, L_{90}, and L_{10} sound levels at Locations A, B, C and D are plotted and shown in Figures 2 through 5. Please refer to Appendix A for definition of the terms "L_{EQ}," "L_{90}," and "L_{10}."

Measurement Site	**L_{10} (dBA)**	**L_{EQ} (dBA)**	**L_{90} (dBA)**
Location A - Band Shell Seating	54 - 65 *	52 - 82 *	49 - 58 *
Location B - 13th St.	52 - 64 *	51 - 67 *	51 - 57 *
Location C – Shuffleboard Courts	49 - 63	48 - 61	47 - 54
Location D – Boulder Library	48 - 67	48 - 97	47 - 55

* Excludes sound levels measured during concert and farmers market

At **Location A**, the hourly average L_{EQ} varied from 51 to 81 dBA. The hourly average L_{90} varied from 50 to 58 dBA. The hourly average L_{10} varied from 53 to 65 dBA.

Between 4:00 – 5:00pm on Friday October 10th the L_{EQ} spiked to 81 dBA. The maximum level recorded during this period was 110 dBA. The L_1 was recorded to be 72 dBA during that hour. Since the L_1 was not affected by this event, we can assume that the event occurred less than 36 seconds, or 1% of duration of the one-hour measurement. Therefore, we hypothesize that the spike in the L_{EQ} was caused by a single or a few short events such as a siren, a loud boom or a hand clap near the microphone.

All sound level metrics significantly increased during the afternoon of Saturday October 11th. This coincides with the scheduled amplified concert at the Band Shell. The peak level of 108 dBA was measured between 12:00 – 1:00 pm. The L_1 between 11:00 am – 2:00 pm was measured to range from 80 – 90 dBA. This is our estimated range of sound levels from the amplification system at the rear of the seating area. We are informed this was Puerto Rican musical workshop. Please keep in mind that some rock concerts may emit much higher sound levels than measured here and some performances may be quieter. We are also unable to distinguish between sound which originate from the audience and sounds which originate from the stage.

When the peak spikes from Friday evening and the Saturday concert and farmers market are excluded, the L_{EQ} varies from 60-70 dBA during daytime and evening hours, and 51-60 dBA during nighttime hours.

At **Location B**, the fifteen minute average L_{EQ} varied from 52 to 66 dBA. The fifteen minute average L_{90} varied from 51 to 55 dBA. The fifteen minute average L_{10} varied from 52 to 63 dBA.

When compared to Locations A and D, Location B recorded more consistent sound levels. One spike measured on Friday morning shortly before 11am recorded a level of 67 dBA. This could have been a siren on Arapahoe Drive or car door slamming on 13th Street. Sounds levels increased very little during the early hours of the farmers market. However levels did increase in around the time of the scheduled concert. The L_1 during the Puerto Rican workshop, 11:00 am – 2:00 pm, was measured in the range of 65 – 70 dBA.

When the time period of the concert is omitted, the L_{EQ} during the daytime is less than 60 dBA.

At **Location C**, the fifteen minute average L_{EQ} varied from 48 to 61 dBA. The fifteen minute average L_{90} varied from 47 to 54 dBA. The fifteen minute average L_{10} varied from 49 to 63 dBA.

The Location C measurements were also very consistent across the weekend. The daytime L_{EQ} typically only varied from 54-58 dBA, and dropped to a low less than 50 dBA at night. This location has a large amount of shielding from traffic noise on Broadway.

At **Location D**, the fifteen minute average L_{EQ} varied from 48 to 97 dBA. The fifteen minute average L_{90} varied from 46 to 55 dBA. The fifteen minute average L_{10} varied from 48 to 65 dBA.

Location D shows many spikes in L_{EQ} throughout the measurement period, but especially during late night hours. As noted earlier, we are hypothesizing that the exceptionally high levels seen in the L_{EQ} are a result of people tampering with our equipment. On Saturday October 11th between 12:00 – 12:15 am, Location D recorded a maximum level of 122 dBA. High level short duration noise events such as this occurred at this location on several occasions, and at various times. Unfortunately, we are unable to accurately distinguish between sirens or short noise bursts on Canyon Road and short noise burst from the people on and around Boulder Creek Path.

When the spikes are omitted, the L_{EQ} is less than 60 dBA during the day.

6.2 SHORT-TERM SOUND LEVELS

To better compare the measurement sites directly, it is helpful to compare the noise levels of certain events or specific time periods. The following table summarizes our notes from the short term monitoring we conducted, identifying common traffic events.

Measurement Site	Typical Bus/Truck Level (dBA)	Typical Car Level (dBA)	Creek / Ambient Level (dBA)
Location A – Band Shell	65 – 70	58 – 60	N/A
Location B – 13th Street	56 – 58	53 – 55	53
Location C – Shuffleboard Courts	55 – 59	53 – 55	52
Location D – Public Library	59 – 61	53 – 55	51

It is clear that traffic noise from buses and cars at the Band Shell measurement location is higher than the others. Location C appears to be the quietest with regards to noise from traffic on Broadway Street and Canyon Boulevard, which are the main thoroughfares and generally the main sources of loud noise.

The following table isolates the Friday evening rush hour for comparison.

Measurement Site	Friday Rush Hour (4:30 – 7:00 pm) L_{10} (dBA)	Friday Rush Hour (4:30 – 7:00 pm) L_{EQ} (dBA)
Location A – Band Shell	62.9	61
Location B – 13th Street	57.9	56.6
Location C – Shuffleboard Courts	56.3	55.3
Location D – Public Library	58.1	56.1

Again, noise levels at the Band Shell are higher, around 5 dBA louder than the other locations. Location C has the lowest L_{EQ} and L_{10} values over the rush hour time frame.

Figures 6 through 11 also show comparison of sound levels at the different measurement locations of isolated times. Figures 7 through 11 show the octave band and 1/3 octave band frequency data. While the noise levels vary somewhat across frequency with measurement location, the Location C frequency content typically shows lower levels than the other locations, with some overlap with Location D at very low and very high frequencies.

7 COMPARISON OF 2014 MEASUREMENTS TO 1995 MEASUREMENTS

It is of interest to the City of Boulder to compare the 2014 measured noise levels to those presented in the 1995 study by Peak Engineering. The following table shows a direct comparison of values at the Band Shell seating, Location A, during specific times of day. We used 2 p.m. as our mid-day measurement point, as the concert and farmers market were taking place into the 12 noon hour.

Time Period	1995 L_{EQ} (dBA)	2014 L_{EQ} (dBA)	1995 L_{MAX} (dBA)	2014 L_{MAX} (dBA)	1995 L_{MIN} (dBA)	2014 L_{MIN} (dBA)
Evening Rush Hour	67.4	61.0	73.2	73.9	63.6	54.7
Weekday Mid-day	63.7	61.5	70.3	75.1	60.3	54.3
Weekend Mid-day	60.4	61.1	69.5	74.7	59.8	54.7

Comparing the L_{EQ} levels, the 2014 evening rush hour and weekday mid-day measurements are lower than the 1995 values, and the weekend mid-day values are essentially the same. The 2014 measurements show higher maximum values but also lower minimum values than the 1995 measurements.

Generally, I would describe the 2014 condition to be quieter than the 1995 conditions. The reasons for this are not clear at this time, but could be due to quieter cars, changes in traffic patterns, or other reasons.

8 BARRIER ANALYSIS

We have conducted a basic barrier analysis of the existing Band Shell site based on the 2014 noise measurements. We used the octave band noise spectrum measured from 8-9 p.m. on Friday evening, at a level of 65 dBA at the Band Shell measurement location to calculate the sound power of traffic noise sources on Broadway Street and Canyon Boulevard.

The loudest traffic noise source is most likely from a bus or large truck accelerating from a stop heading North on Broadway Street, or West on Canyon Boulevard. Placing a barrier wall along the inner boundary of the sidewalk along these streets would be the best location to reduce traffic noise.

We calculate the following maximum theoretical noise reductions based on barrier height:

Barrier Height	Maximum Noise Reduction	Resulting LEQ
8’	6 dBA	59 dBA
10’	9.5 dBA	55.5 dBA
12’	12 dBA	53 dBA

This assumes that the barriers follow the entire length of the streets, blocking line of sight to all traffic, which would be difficult given the bike path layouts and the bridge over Boulder Creek. Additionally, there will be sound reflections off of the 3 and 4-story buildings on the north side of Canyon Boulevard, reducing the effectiveness of the barrier on that street.

Because of these realities, even with a 12' tall barrier, we do not believe that you can reduce traffic noise levels to below 55 dBA at the existing Band Shell location.

9 CONCLUSIONS

Ambient sound levels were measured at four locations in Boulder Central Park, at the existing Band Shell site and three other locations.

The existing Band Shell site is the loudest of the four locations measured. Average noise levels exceed 60 dBA during daytime and evening hours, when events at the Band Shell are most likely to occur. Based on our barrier analysis, we do not believe that noise levels from traffic can be effectively reduced to below 55 dBA at the existing location.

Noise levels measured at the three other locations were quieter, mostly due to their further distance from the intersection of Broadway Street and Canyon Boulevard. We believe using one of these three alternate locations offers the best chance to achieve an ambient noise environment less than 55 dBA, and potentially even quieter depending on the site layout and extent of sound attenuation measures implemented.

A 3 dB change in level is usually the smallest change that is perceptible to normal hearing adults, while a 10 dB change in level is often described as twice (or half) as loud. The following table provides subjective perceptions of change in sound levels:

Change in Level	Human Perception
1 dB	Imperceptible
3 dB	Just perceptible
5 dB	Clearly noticeable
10 dB	Substantial change

The difference between the current location and the shuffleboard courts is approximately 6 dB on average. This is more than a "clearly noticeable" difference, but not enough to be considered half as loud. At the current location with the background levels greater than 60 dBA, even conversational speech at close proximity can be difficult, and raised voice levels are needed during busy traffic times. At the shuffleboard courts, conversational speech was not difficult.

Another thing to consider is that a 6 dB reduction in background noise means that you allow the performers on stage a wider dynamic range, by allowing them to perform a little bit softer. One of the complaints you mentioned to me was that when you have an orchestra on stage, the traffic is very distracting when particularly loud vehicles go by, and you are probably losing a lot of the quiet portions of the pieces. By lowering the noise floor, you have the potential to hear some of the quieter interludes that you may have lost previously.

Considered absolutely, 55 dBA is still too loud of a background noise level for unamplified symphonic or speech events, unless you are sitting very close to the stage. If you are sitting

further than about 30-40’ from the stage, you will lose most of the quiet parts to the background noise. However, 55 dBA is an acceptable background level for amplified speech and music events.

Please feel free to call if you have any questions or would like to discuss this further.

Digitally signed by David Manley
Date: 2014.12.19 11:53:06-07'00'

Prepared by: _____
David Manley, P.E.
Senior Consultant

APPENDIX A

Acoustical Terminology and Definitions
Typical Sound Levels Chart

Acoustical Terminology and Definitions

Ambient noise: The composite of airborne sound from many sources near and far associated with a given environment. No particular sound is singled out for interest.

A-weighted sound level: The A-weighted sound level is a single number rating which reflects most closely the human perception of sound levels, which is generally less sensitive to sounds at low frequencies than at mid and high frequencies. The A-weighted level is calculated by combining decibels from each octave band, while applying an ANSI specified weighting factor to each band. This system expresses sound levels in units of A-weighted decibels (dBA).

Background noise: noise from all sources unrelated to a particular sound that is the object of interest. Background noise can be short term or long term. A passing vehicle would be considered short term, while the "din" of a distant highway would be considered long term background noise.

Decibel (dB): A common unit used for sound pressure level; equal to ten times the common logarithm of the ratio of two like quantities proportional to power or energy.

Equivalent sound level (L_{EQ}): A measure of sound energy over a period of time, or a sound level which, in a stated period of time, would contain the same acoustical energy as the time-varying sound during the same period. The actual instantaneous noise levels typically fluctuate above and below the measured L_{EQ} during the measurement period. The A-weighted L_{EQ} is a common descriptor for measuring environmental noise.

Minimum sound level (L_{MIN}): The minimum sound pressure level that occurred during the measurement duration.

Maximum sound level (L_{MAX}): The minimum sound pressure level that occurred during the measurement duration.

Statistical Sound Levels: The sound levels of long-term noise producing activities such as traffic movement, aircraft operations, etc., can vary considerably with time. In order to obtain a single number rating of such a noise source, a statistically-based method of expressing sound or noise levels has been developed. It is known as the Exceedance Level, L_N. The L_N represents the sound level that is exceeded for N% of the measurement time period. For example, L_{10} = 60 dBA indicates that for the duration of the measurement period, the sound level exceeded 60 dBA 10% of the time.

10-percentile-exceeded sound level (L_{10}): The sound pressure level that was exceeded 10% of the time during the measurement duration. During long-term unattended sound level measurements, the L_{10} value is often referenced as a good approximation of noise levels due to vehicular traffic.

90-percentile-exceeded sound level (L_{90}): The sound pressure level that was exceeded 90% of the time during the measurement duration. During long-term unattended sound level measurements, the L_{90} value is often referenced as a good approximation of background noise levels excluding vehicular traffic.

Octave band: An internationally accepted frequency band, or range, commonly used to divide the audible frequency range into ten bands. An octave band is a frequency band with an upper frequency limit twice that of its lower frequency limit. Octave bands are identified by their respective center frequencies (e.g., 31.5, 63, 125, 250, 500, 1,000, 2,000, 4,000, 8,000, and 16,000 Hertz). Octave bands are *proportional* bandwidth bands since their bandwidth gets larger with increasing frequency.

One-third octave band: An internationally accepted frequency band, or range, commonly used to divide the audible frequency range into 31 bands. Three 1/3 octave bands make up an octave band. One-third octave bands are identified by their respective center frequencies (e.g., 31.5, 40, 50, 63, 80, 100, 125, 160 Hertz, etc.). One-third octave bands are *proportional* bandwidth bands since their bandwidth gets larger with increasing frequency.

Sound pressure level: Sound or noise consists of minute fluctuations in atmospheric pressure capable of evoking the sense of hearing. Technically, it is twenty times the common logarithm of the ratio of the sound pressure under consideration to the standard reference pressure of 20 μPa. The quantity so obtained is expressed in decibels.

Sound pressure (Pa)	Sound intensity (W/m^2)	Sound intensity level or sound pressure level (dB)	Noise in the environment
63.2	10	130	Threshold of pain
20	1	120	Near a jet aircraft at take-off
6.32	0.1	110	Riveting machine
2.0	0.01	100	Pneumatic hammer
0.632	0.001	90	
0.2	0.0001	80	Diesel truck at (15 m) 50 ft Shouting at 1 m (3 ft)
0.0632	0.00,001	70	Busy office
0.02	0.000,001	60	Conversational speech at 1 m (3 ft)
0.00632	0.0,000,001	50	Quiet urban area during daytime
0.002	0.00,000,001	40	Quiet urban area at night
0.000632	0.000,000,001	30	Quiet suburban area at night
0.0002	0.0,000,000,001	20	Quiet countryside
0.000632	0.00,000,000,001	10	Human breathing
0.00002	0.000,000,000,001	0	Threshold of audibility

1.10 *Some typical noises in our environment and their sound intensities and sound intensity levels.*

From: *Architectural Acoustics, Principles and Design* by Mehta, Johnson, & Rocafort

Figure 1. DLAA Measurement Locations - October 2014

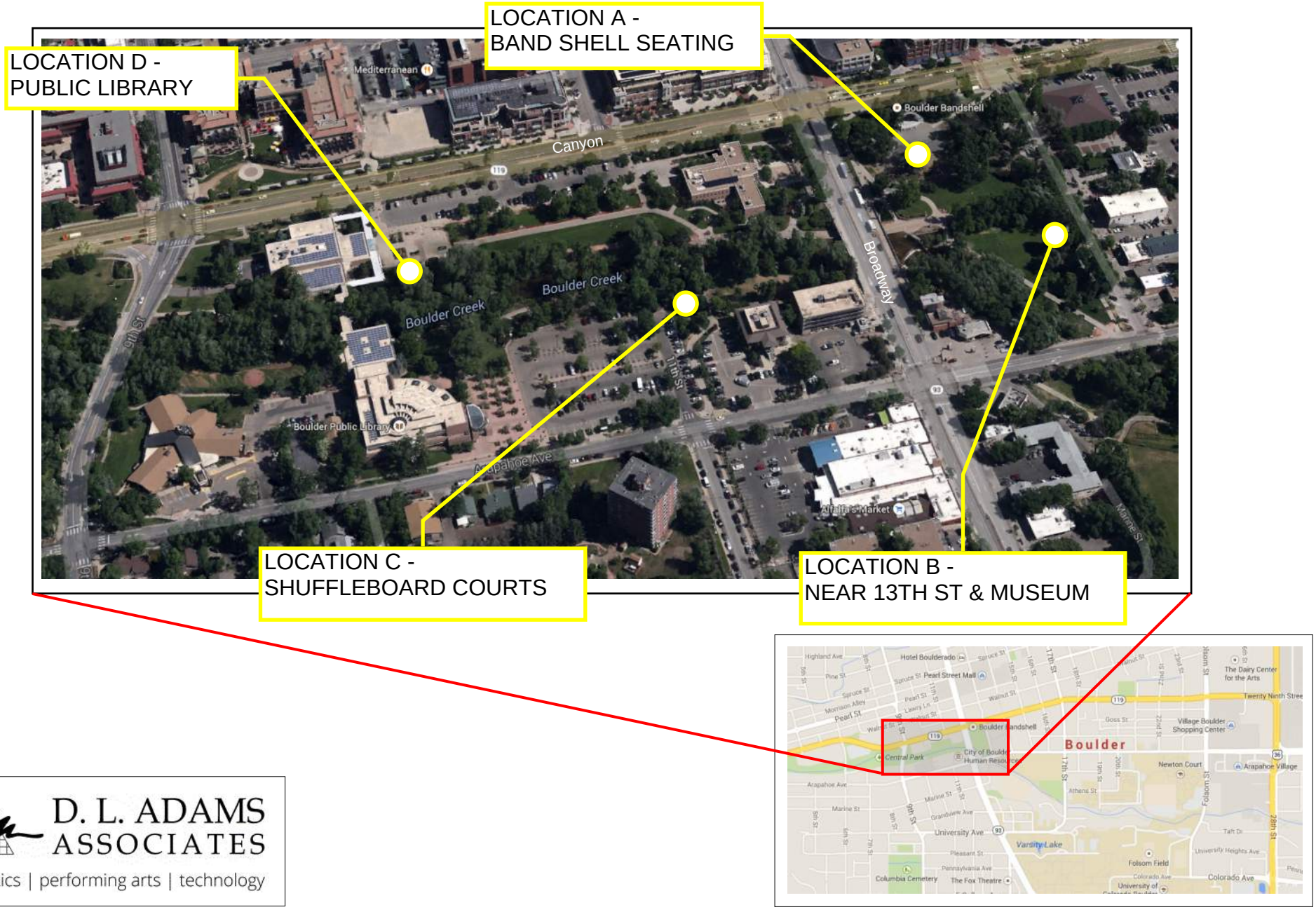

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Figure 2. Sound Levels at Location A (Bandshell Seating)

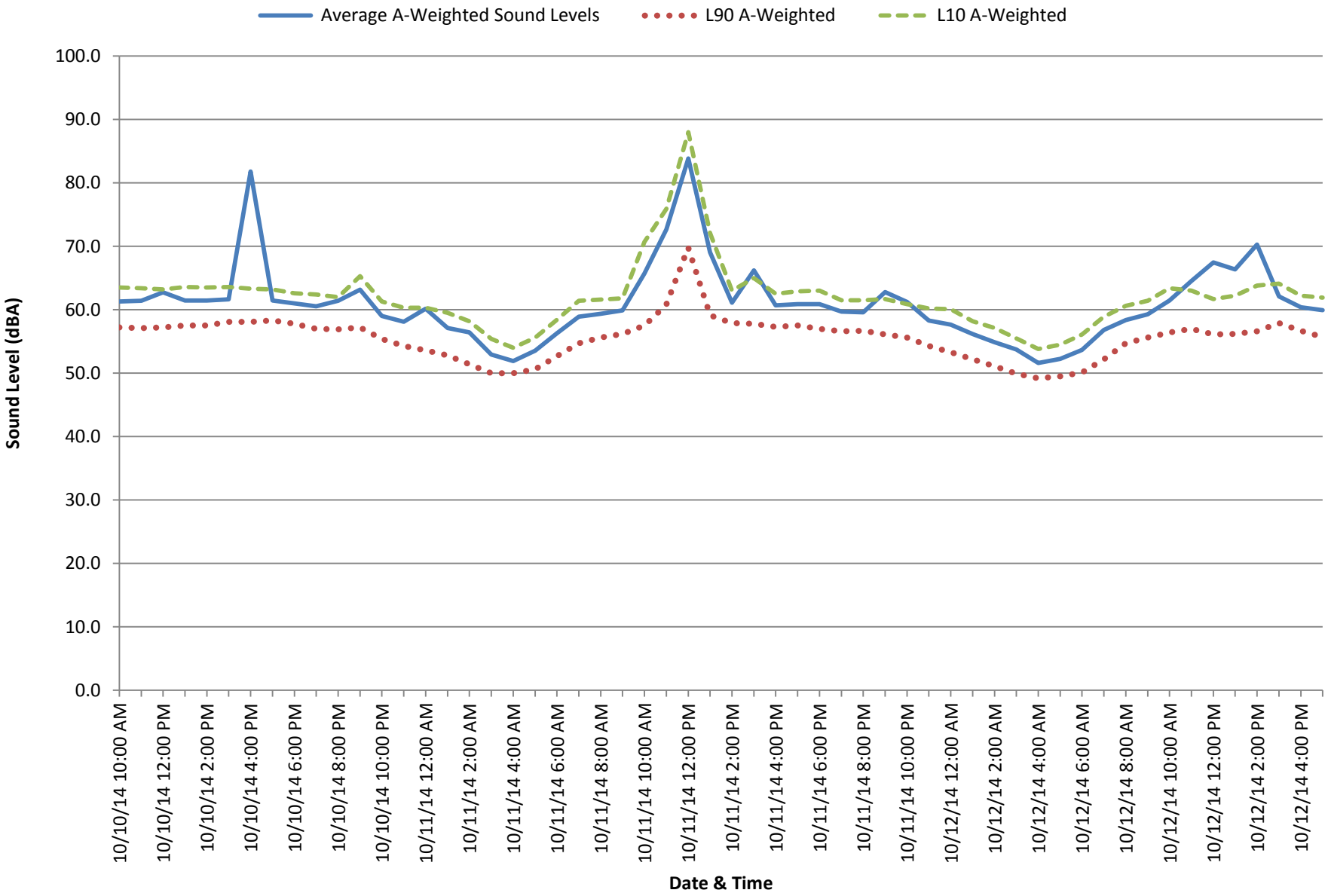

Figure 3. Sound Levels at Location B (13th St)

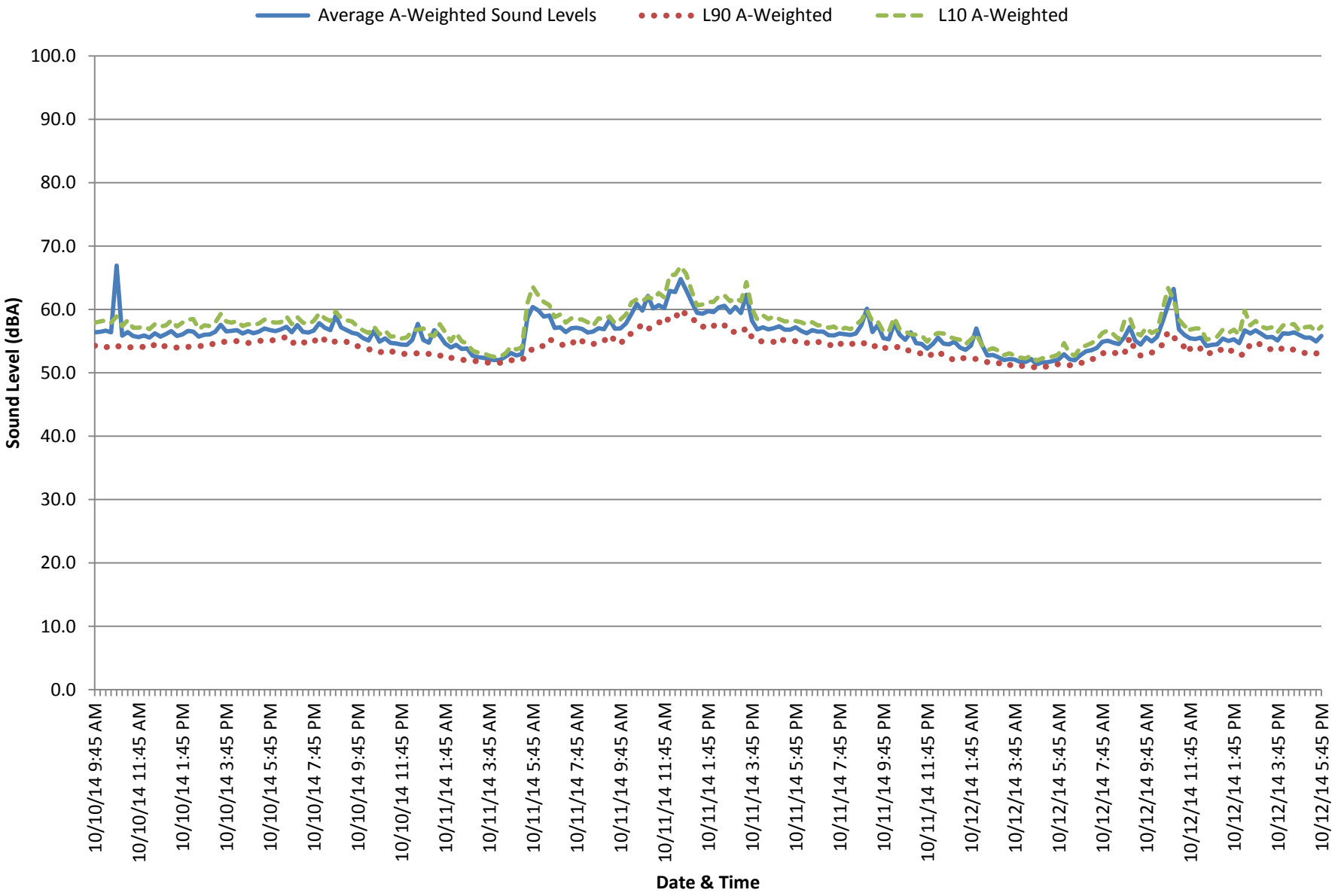

Figure 4. Sound Levels at Location C (Shuffleboard Courts)

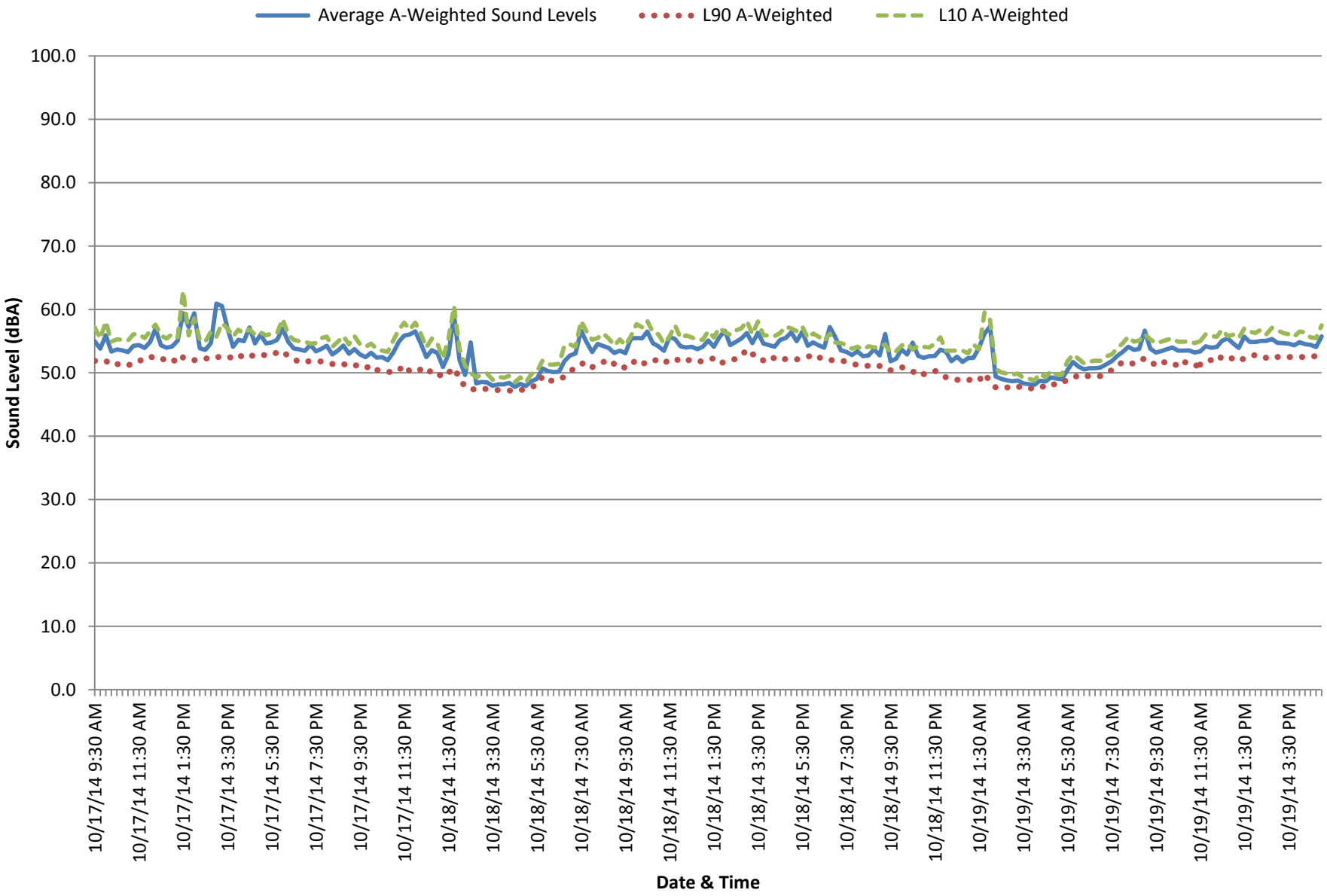

Figure 5. Sound Levels at Location D (Library)

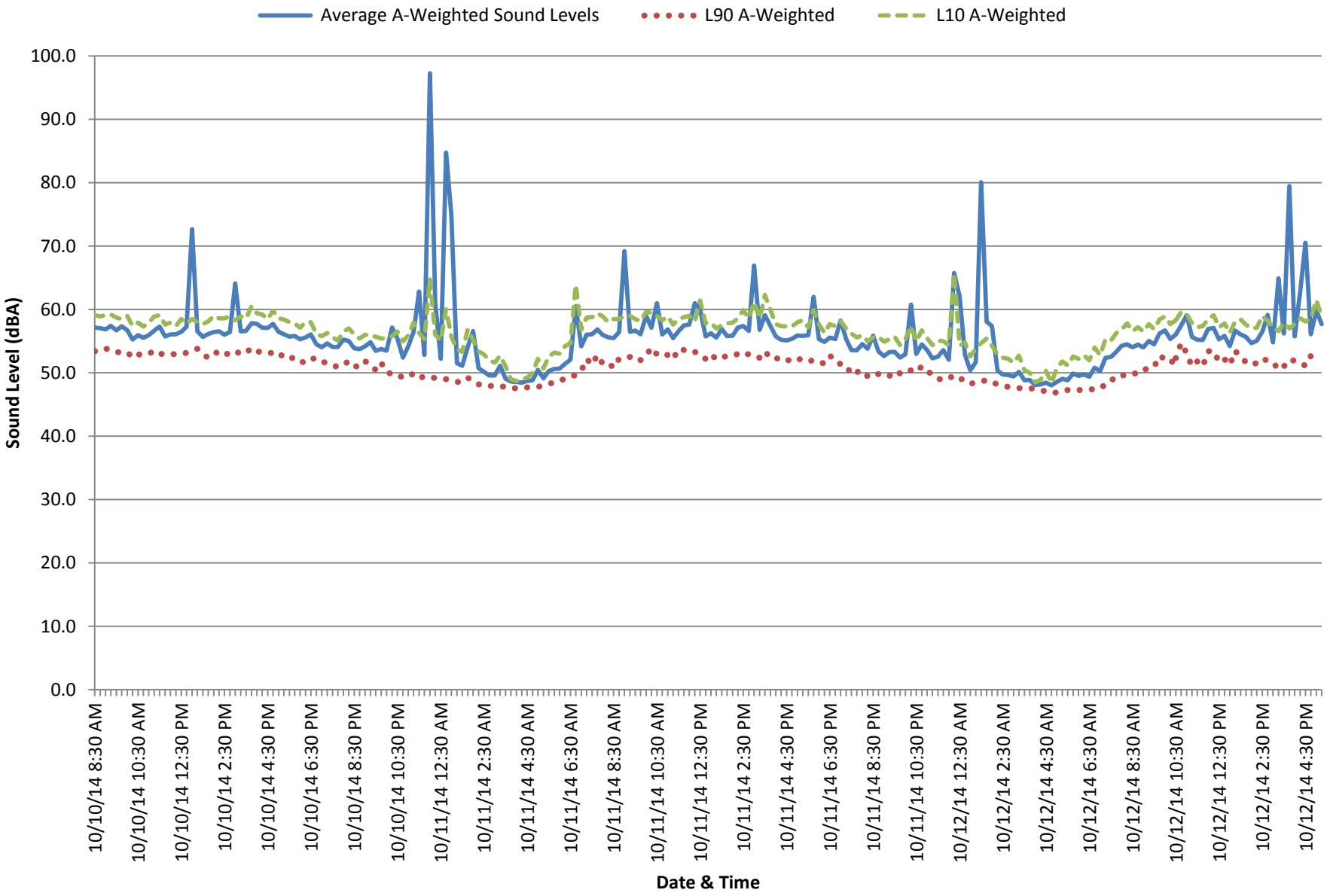

Figure 6. Average Sound Levels on Friday & Saturday 8:00 - 9:00pm

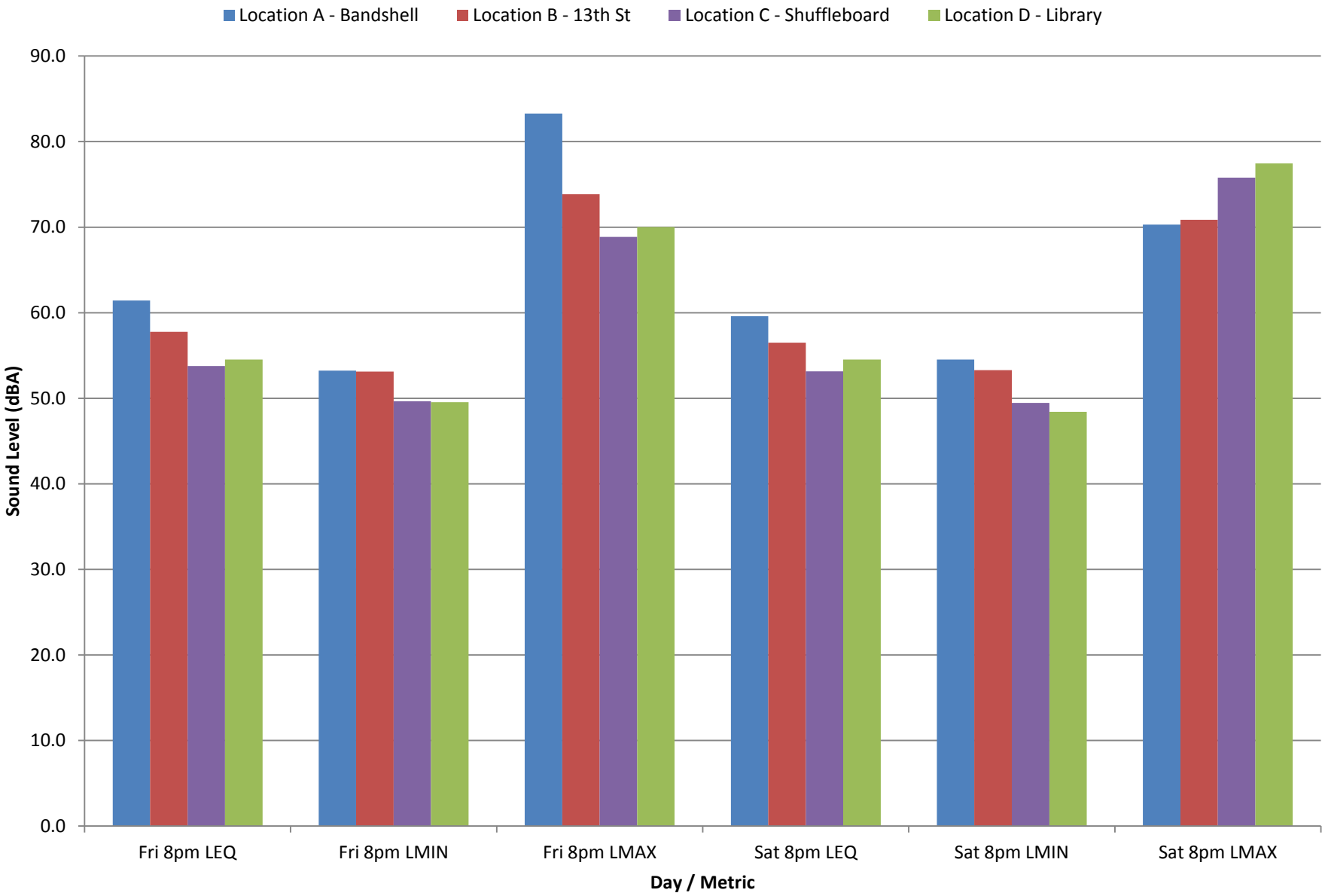

Figure 7. Average Octave Band Sound Levels on Friday 8 - 9pm

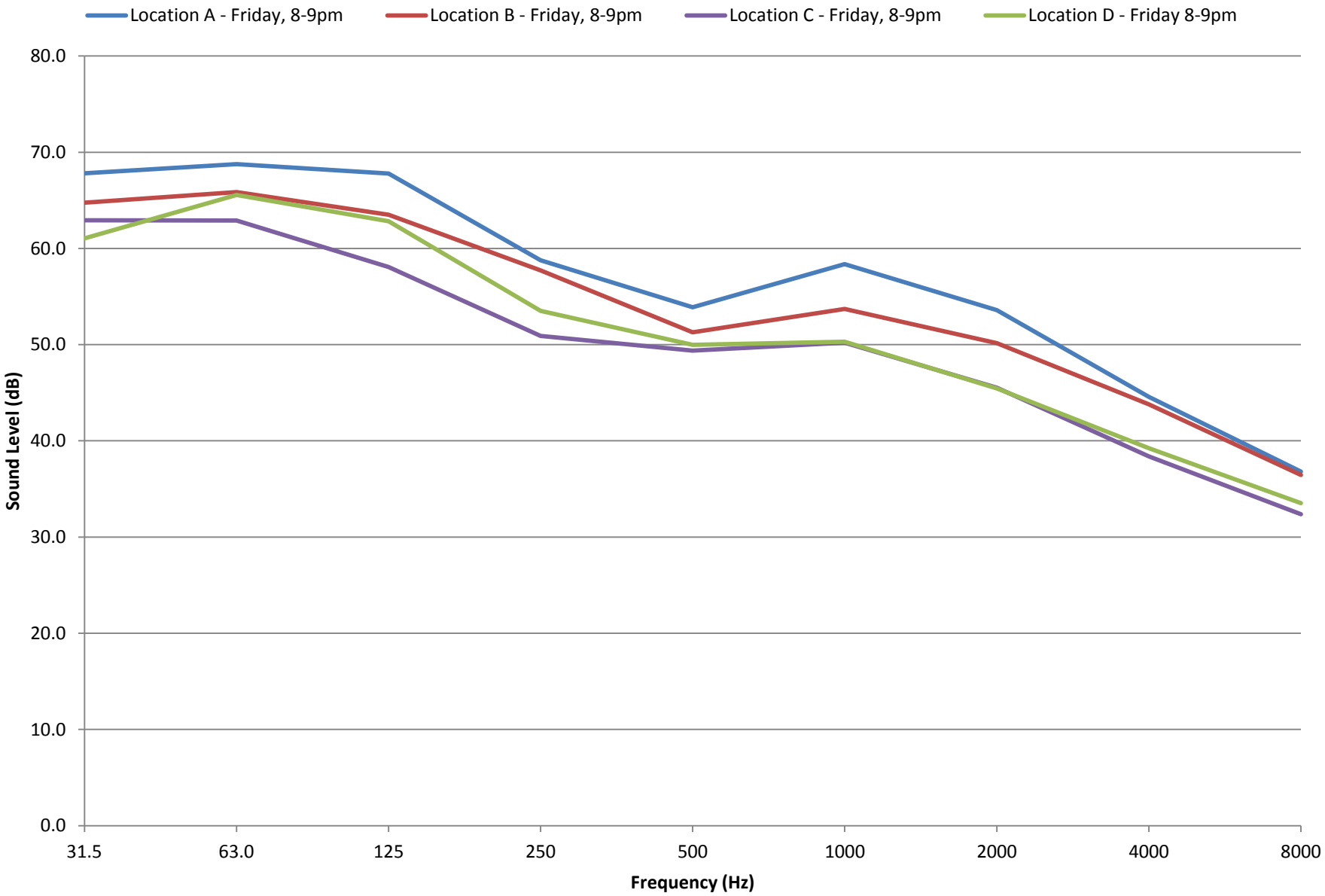

Figure 8. Average 1/3 Octave Band Sound Levels Friday 8-9pm

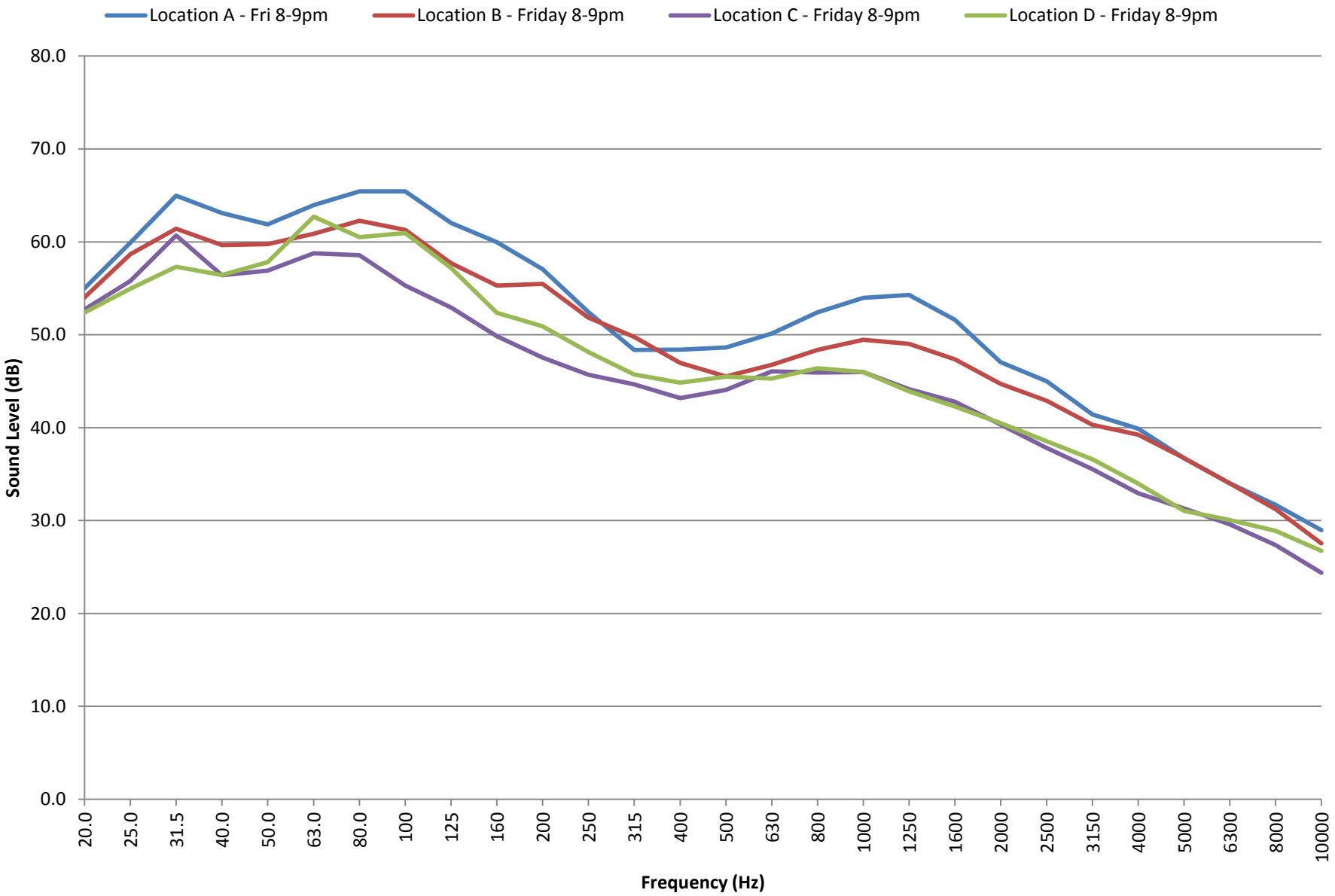

Figure 9. Avergae Octave Band Sound Levels Saturday 8-9pm

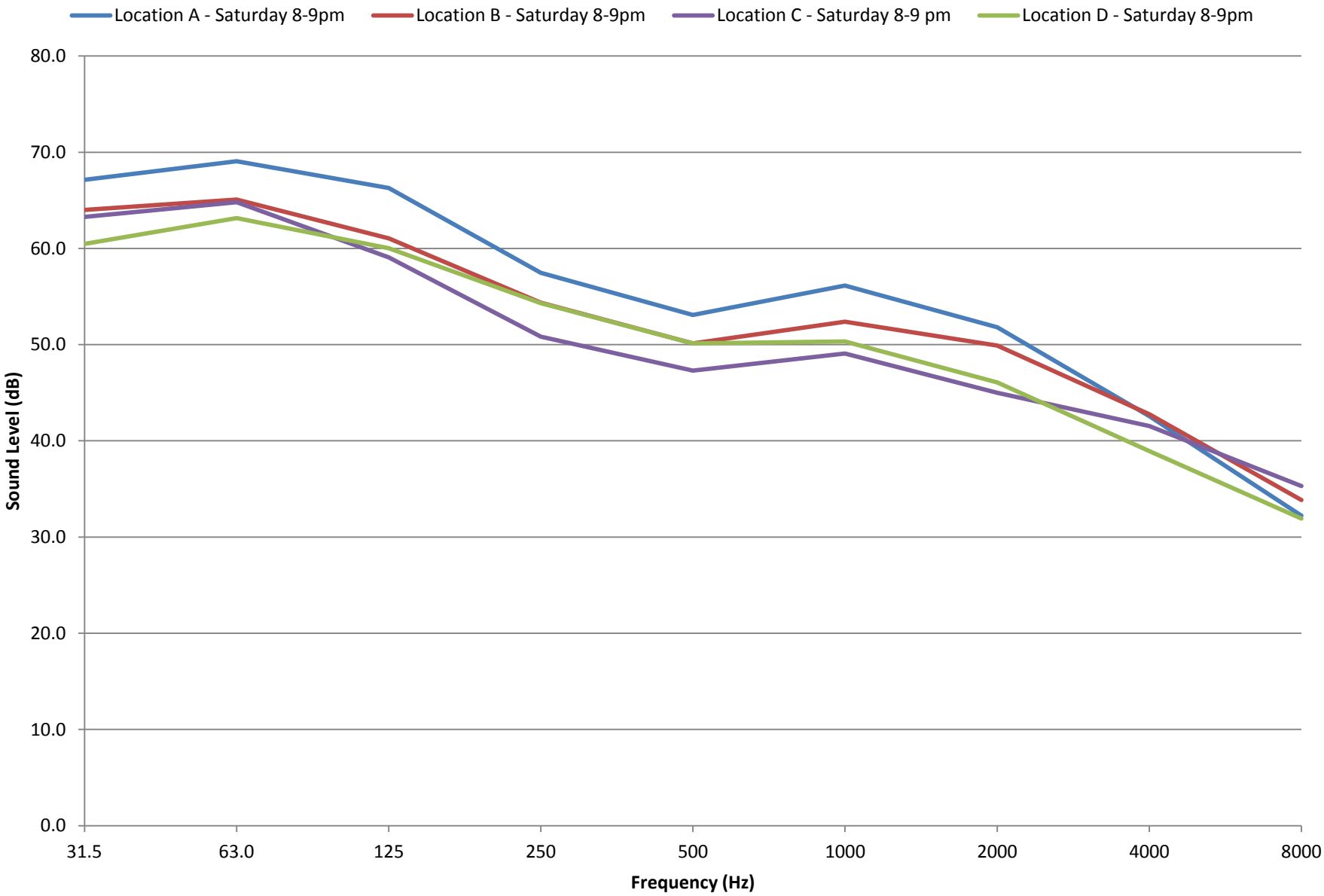

Figure 10. Average 1/3 Octave Band Sound Levels Saturday 8-9pm

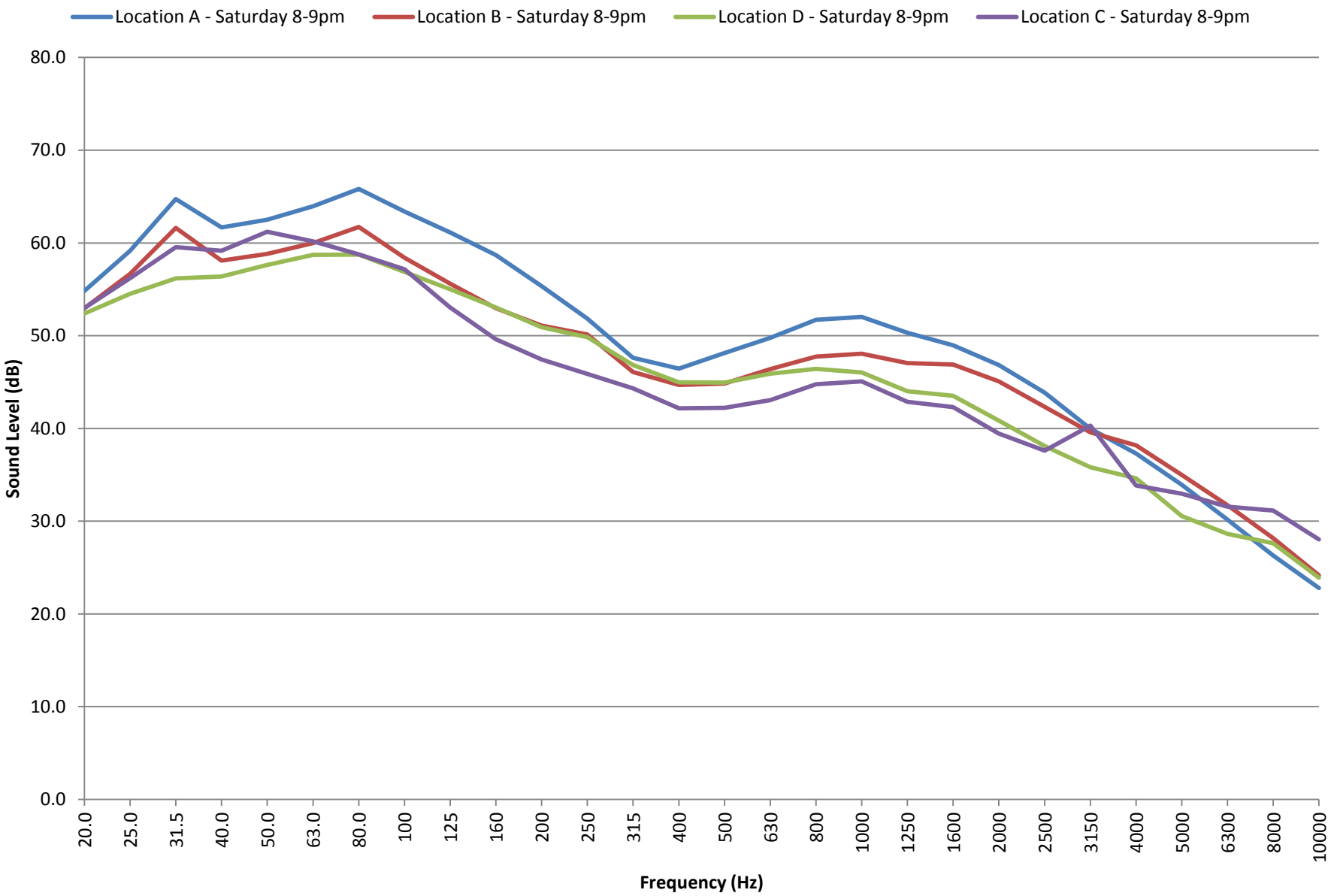

Figure 11. Average 1/3 Octave Band Sound Levels Friday 4:30 - 7:00pm